

### **REMARKS**

This paper is submitted in reply to the Office Action dated March 5, 2007. In addition, Applicants respectfully request that a one-month extension of time be granted to respond to the Office Action mailed March 5, 2007, and that the Examiner consider this a petition therefor. The period of response extends up to and includes July 5, 2007, and this paper is timely filed. Authorization for a Credit Card charge of \$120.00 for the one-month extension fee is hereby included in the Electronic Fee Sheet attached. Reconsideration and allowance of all pending claims by the Examiner are therefore respectfully requested.

In the subject Office Action, claims 1, 3-16 and 18-23 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Application Publication No. 2004/0210563 to Zait et al. and further in view of U.S. Patent No. 6,502,089 to Amundsen et al.

Applicants respectfully traverse the Examiner's rejections to the extent that they are maintained. Applicants have canceled claims 12-16 and 18-23 and amended claims 1 and 6-9. Applicants respectfully submit that no new matter is being added by the above amendments, as the amendments are fully supported in the specification, drawings and claims as originally filed. Applicants also note that the amendments made herein are being made only for facilitating expeditious prosecution of the aforementioned claimed subject matter. Applicants are not conceding in this application that the originally-claimed subject matter is not patentable over the art cited by the Examiner, and Applicants respectfully reserve the right to pursue this and other subject matter in one or more continuation and/or divisional patent applications.

As an initial matter, Applicants wish to thank the Examiner and the Examiner's supervisor for the consideration granted in the telephone interview conducted with the undersigned on June 20, 2007. In the interview, Applicants proposed amendments to claim 1 to address the Examiner's rejections. The Examiner did indicate that additional language in the claim, directed to clarifying that the portions of the result set included records that meet all of the join operations in the query, would be favorably considered. The Examiner also agreed to contact the undersigned should the Examiner require any additional

amendments in order to pass the case to allowance. Applicants urge the Examiner to contact the undersigned at 513-241-2324 should there be any outstanding issues that remain to be resolved prior to allowing the Application.

Turning now to the Examiner's rejections, and in particular the art-based rejections, the Examiner will note that Applicants have canceled all independent claims, with the exception of claim 1, in an attempt to narrow the number of outstanding issues in the Application. It is Applicants intent to file a continuation application prior to issuance of this application to pursue some or all of the canceled subject matter.

Claim 1, as amended herein, recites a method for monitoring a query during runtime, where the query involves a plurality of join operations. The method includes in part running the query according to a first join order, generating a first portion of a result set for the query while running the query according to the first join order, collecting performance statistics about each of the join operations concurrent with running the query, changing the first join order, during running of the query, to a second join order based on the statistics, and generating a second portion of the result set for the query while running the query according to the second join order.

Claim 1 also now clarifies that generating the first portion of the result set includes "adding to the result set a first record that matches the plurality of join operations in the query," and that generating the second portion of the result set includes "adding to the result set a second record that matches the plurality of join operations in the query such that the result set includes at least the first and second records." In addition, claim 1 clarifies that the change from the first join order to the second join order occurs "dynamically." Finally, claim 1 now clarifies that the first and second portions of the result set are generated for the same execution of the query. Support for these amendments may be found, for example, at page 14, lines 10-22, page 16, lines 9-11, and page 19, lines 8-19 of the Application as filed. In addition, claims 6-9 have been amended for consistency with the amendments made to claim 1.

As such, claim 1 effectively recites in part the concept of dynamically changing join order during the execution of a query such a result set generated from the query

includes a first record that is found to match the query when a first join order is used and a second record that is found to match the query after the first join order has been dynamically changed to a second join order.

In rejecting claim 1, the Examiner relies on Zait and Amundsen. However, as Applicants have previously noted, neither Zait, nor Amundsen discloses or suggests using the results of statistics collection to modify the execution of a query during the same execution of the query during which the statistics were collected. Zait does collect statistics during the execution of a query, but the collected statistics are only used to optimize the performance of later queries, including potentially later executions of the same query. Paragraphs [0034]-[0036] disclose optimizing a query statement, but it is clear from that passage that the optimization will only apply to further executions of that statement, rather than the execution during which the statistics are collected. Figs. 7 and 8 of Zait, as well as paragraphs [0034]-[0036] which discuss these figures, refer to improving the performance of a query statement, or generating a new execution plan or selecting another execution plan for that query statement. There is no disclosure or suggestion in these passages, however, that the updates to the execution plan used by a query statement are used in the same execution of the query statement during which statistics are collected. Indeed, block 710 of Fig. 7, which refers to improving the performance of the query statement, is performed just before the end of the flowchart, and does not refer to continuing to run the query. Zait still provides a performance benefit in that the next time the same query is run, the improved performance will be realized. However, Zait does nothing to address any sub-optimal performance of a query that is currently being executed.

In rebutting Applicants' arguments in the latest Office Action, the Examiner argues at pages 19-20 that Zait, by disclosing improving the performance of a query statement, effectively discloses improving the performance of the "same query." As Applicants noted in the interview, however, a query, or query statement, can be executed multiple times, e.g., by different users or by the same user, and each such execution generates a separate result set. By stating that a "query statement" is improved, Zait is disclosing that the next time that query statement is executed, the performance will be improved. In fact,

paragraph [0034] explicitly states that improving the performance includes “altering the execution plan,” suggesting that the next time the query statement is executed, the modified execution plan will be used in lieu of the original execution plan that was used when the statistics were collected.

Claim 1 recites that first and second portions of the same result set, for the same execution of a query, are generated before and after a dynamic change in join order. Furthermore, each of these portions includes at least one record that matches the plurality of join operations in the query. As such, the overall result set includes matching records found using both of the first and second join orders. Furthermore, the matching record added to the result set before the dynamic change is retained in the result set after the change is made (by virtue of the first and second records being included in the result set after the second record is added).

Zait does not disclose, nor does it suggest, retaining any matching records in a result set that were added prior to changing any execution plan, and then continuing to add additional matching records to the same result set after the execution plan is altered. This is because Zait simply does not disclose or suggest using collected statistics to modify a currently executing query execution plan. As such, Zait does not disclose or suggest dynamically changing join order during the execution of a query such a result set generated from the query includes a first record that is found to match the query when a first join order is used and a second record that is found to match the query after the first join order has been dynamically changed to a second join order.

Amundsen does not remedy the shortcomings of Zait, and adds little to the rejection. Amundsen describes the use of relational tensors to describe the contents of database tables. These tensors can be used to generate statistics, e.g., to determine potential fan out of multiple joins and recommend a join order during generation of an execution plan. These statistics, however, are used to generate the initial execution plan, and are calculated prior to generating and executing the execution plan. In this regard, the selection of a join order in the manner described in Amundsen is similar to that described at page 4 of the Application, where the join order is selected prior to executing the query

and generating a result set. As such, like Zait, Amundsen does not disclose or suggest dynamically changing join order during the execution of a query such a result set generated from the query includes a first record that is found to match the query when a first join order is used and a second record that is found to match the query after the first join order has been dynamically changed to a second join order.

The Examiner relies principally on col. 23 of Amundsen for arguing that Amundsen discloses generating first and second portions of a result set using first and second join orders. However, the Examiner's basis for the argument is not consistent with the manner in which multiple joins are performed. Amundsen does disclose in col. 23 that statistics can be used to predict the number of "intermediate results" that will be produced. These "intermediate results", however, are not results that match all of the join operations in a multi-way join, as required by claim 1. First, these intermediate results are predicted results calculated from the statistics, not actually records that are added to a result set. The passage explicitly states "number of intermediate results that will be produced" (emphasis added), and furthermore, these results are not even records, they are predictions of the number of records.

Second, these intermediate results are "intermediate" to the extent they reflect records that are predicted to match one join operation in a multi-way join, but not necessarily all join operations. The passage at col. 23 refers to a multi-way join with a first relation joined to a second relation, and then a second relation joined to a third relation. The intermediate results refer to the numbers of records that are predicted to match with either the join between the first and second relations, or the join between the second and third relations ("it is useful to know the join fanout, i.e., number of intermediate results that will be produced by, the join of the first and second relations as compared to the join fanout of the join of the second and third relations."). In a multi-way join, however, only those records that match both of the first and second joins will ultimately be added to a result set.

It is also important to note that claim 1 refers to "join orders" and not to "joins". Col. 23 of Amundsen refers to first and second joins, but not to first and second join orders,

and the intermediate results are what is predicted to occur when one join is processed before another. The intermediate results are not even arguably analogous to results that are generated prior to changing a first join order to a second join order. In fact, due to the nature of multi-way joins, multiple joins are effectively “nested,” and not actually performed in series, so the intermediate results referred to in Amundsen do not even refer to the results of performing multiple joins according to a join order.

In addition, it is important to note that claim 1 requires that the first record added to the first portion of the result set before changing from the first join order to the second join order “matches the plurality of join operations.” It is not sufficient for the purposes of claim 1 that a record that matches only one of the plurality of join operations be added to a result set. Consequently, to the extent the Examiner considers the “intermediate results” to be analogous to a first portion of a result set, the intermediate results discussed in Amundsen refer only to those records that match one join operation, rather than records that match all (i.e., the “plurality”) of the join operations in a multi-way join.

As a result, the “intermediate results” discussed in Amundsen do not correspond to a “portion of a result set” as required by claim 1. Amundsen does not disclose or suggest dynamically changing join order during the execution of a query such a result set generated from the query includes a first record that is found to match the query when a first join order is used and a second record that is found to match the query after the first join order has been dynamically changed to a second join order.

The proposed combination of Zait and Amundsen therefore falls short of disclosing or suggesting each and every feature of claim 1. Neither reference discloses or suggests dynamically changing a join order during the execution of a query. In addition, neither reference discloses or suggests creating a single result set that includes records added according to two different join orders, with one of such records being added before a change in join order and another of such records being added after such a change. Claim 1 is therefore non-obvious over Zait and Amundsen. Reconsideration and allowance of claim 1, and of claims 3-11 which depend therefrom, are respectfully requested.

As a final matter, Applicants traverse the Examiner's rejections of the dependent claims based upon their dependency on the aforementioned independent claims. Nonetheless, Applicants do note that a number of these claims recite additional features that further distinguish these claims from the references cited by the Examiner. However, in the interest of prosecutorial economy, these claims will not be addressed separately herein.

In summary, Applicants respectfully submit that all pending claims are novel and non-obvious over the prior art of record. Reconsideration and allowance of all pending claims are therefore respectfully requested. If the Examiner has any questions regarding the foregoing, or which might otherwise further this case onto allowance, the Examiner may contact the undersigned at (513) 241-2324. Moreover, if any other charges or credits are necessary to complete this communication, please apply them to Deposit Account 23-3000.

Respectfully submitted,

June 21, 2007

Date

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